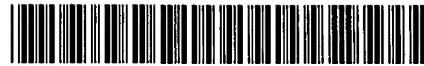




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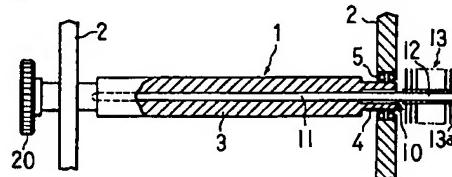
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### (54) Thermal roller using heat pipe.

(57) A roller having a solid or hollow roller body (3) and one or more heat pipes (10) disposed along a central axis of the roller body from its one end. A portion (12) of the heat pipe is extended from the roller body (3). The extended portion (12) of the heat pipe has thereon a radiation device (13) which is prepared as to be a fin type. When heating the roller, the extended portion (12) of the heat pipe (10) will be utilized as an heat-inlet section, so that the applied heat is transmitted to the roller body (3). While, cooling the roller, the mentioned heat-inlet section is then used as a radiation device to release the heat from the roller body (3).

FIG. 1



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## FIELD OF THE INVENTION

This invention is broadly concerned with inking rollers in a printing machine or several rollers in a machine for processing plastic films and intended particularly to be used to a heating or cooling roller (referred to as a thermal roller in the following description) being in control of its surface temperature by being heated or cooled.

## DESCRIPTION OF THE PRIOR ART

Rollers rotating in contact with others are generally employed in several machinery. Taking for an instance, there are arranged several inking rollers between an ink reservoir and a plate cylinder in the printing machine to feed ink to plates which are attached to the plate cylinder by transmitting ink sequentially from one roller to the other contiguous roller. These rollers are apt to go up the temperature of ink on the surface thereof due to a rolling friction heat generated by rotate in contact with others. But, according to specifications of ink, several conditions such as an admirable temperature and range of temperature in use of ink are prescribed. The preferable temperature of ink in offset press is generally recommended to be about 28 degrees. It is then noted that the surface temperature of the inking roller being out of the mentioned conditions for ink becomes a main cause to spoil quality of printed papers. It is also observed in a case of low room temperature in a cold district that the printing machine should be idled until the temperature of ink reaches to the admirable one for the start of daily work, which causes a drop in productivity.

Reflecting such prior art in this field of invention, some of technology to cool and heat the roller have been proposed so as to keep the surface temperature of roller preferable level. Some of known technology to cool the roller are as follows; a water-cooled method wherein a water such as ground water is circulated in the roller, a freeze-cycle method wherein a heat exchange is effected by a cooling water or refrigerant, and a heat-pipe method. An official gazette issued January 11th in 1988 under the Japanese Patent Laid-open No. SHO 63-5944, as an example of conventional technology, described a cylinder-cooling device applying the freeze-cycle method. As another reference, the Japanese Patent Laid-open No. HEI 3-21453 issued on January 30th in 1991 proposes a method of controlling the temperature of ink on the plate attached to a plate cylinder, wherein a fluid medium is circulated in the plate cylinder to control the temperature of ink by regulating the fluid medium.

Accordingly, it will be observed that a thermal roller employing a fluid medium should be closed up tightly and produced precisely. Moreover, such a conventional device essentially needs a water or heated water circulatory device and a refrigerator, which is undesirable in view of the space. Furthermore, there may be a complicated control to effect a desirable operation behind the conventional device and a troublesome maintenance.

## SUMMARY OF THE INVENTION

It is an object of the present invention to provide a roller which is enough to have a little components to be heated or cooled upon a necessity, and which is preferable in view of maintenance.

According to this invention, heat pipe are coupled into a roller body from its one end so as to extend partly, so that a components to heat or cool the roller can be minimized. Furthermore, since a thermal transmissible member can be filled in to, so that maintenance become easy.

According to one preferable embodiment of this invention, a roller to be heated or cooled has a solid roller body having a hole provided from at least one end along a central axis thereof and one or more heat pipes coupled into one or more holes of the roller body to partly extend therefrom.

When heating the roller, the heat pipe extended from the roller body is first heated and the applied heat is transmitted to the roller body. While, cooling the roller, unnecessary heat is released from the heat pipe. If fins are provided on the heat pipe extended from the roller body, thermal transmission will be accelerated to facilitate preferable thermal control.

## BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1 is a fragmentary sectional view of a thermal roller using a heat pipe according to this invention.

Figure 2 is an enlarged front view of a modification of a fin-type radiation device.

Figure 3 is a side view from the A-A line in Figure 2.

Figure 4 is an explanatory view of a device for compulsorily cool the radiation device of the heat pipe by air.

Figure 5 is a sectional view of a thermal roller using two independent heat pipes.

Figure 6 is a sectional view of a thermal hollow roller using a plurality of heat pipes.

Figure 7 is a sectional view taken along the B-B line in Figure 6.

Figure 8 is a sectional view from the C-C line in Figure 6.

Figure 9 is a sectional view of a thermal hollow roller using heat pipes in an inner sleeve.

Figure 10 is a sectional view taken along the D-D line in Figure 9.

Figure 11 is a sectional view taken along the D-D line in Figure 9 to show another arrangement of heat pipes.

Figure 12 is a sectional view of another modification of roller composition.

Figure 13 is a sectional view taken along the E-E line in Figure 12.

Figure 14 is a sectional view showing a modification of roller composition and an embodiment of a heat/cool device employing an electrical thermal element.

#### DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT(S)

The preferred embodiments of the present invention will now be described with reference to the drawings. Figure 1 shows the overall composition of a thermal roller (referred to as a roller in the following description) having a heat pipe which is coupled thereto along the axis thereof. The roller is arranged to have a radiation section or a heat-inlet section therein to go up its temperature having heat and to give off heat from the roller body to go down its temperature. As can be understood, a fundamental composition of the roller in this embodiment is almost the same, so that only a roller which should be cooled will be explained in detail.

A roller 1 comprises a roller body 3 of which a shaft 4 is rotatably supported in a bearing 5 fixed to a side frame 2 of a whole device. The roller body 3 is provided with a deep hole axially aligned with its axis therein which receives an heat-inlet section 11 of a heat pipe 10. A radiation section 12 of the heat pipe 10 is extended from one end of the roller 1 and projected over the side frame 2. At the other end of the roller 1, there is provided a drive gear 20 to rotate the roller. The radiation section 12 of the heat pipe 10 has thereon a radiation device 13 including plural fins.

The heat pipe 10 contains a working fluid such as water or freon after decompressing the inside pressure. The contained working fluid is once vaporized at the heat-inlet section 11 by heat and then moved to the radiation section 12 to be condensed. The thus condensed working fluid is returned to the heat-inlet section 11 so that a heat transfer from the heat-inlet section 11 to the radiation section 12 is effected to thereby cool the roller.

The radiation device 13 includes a plurality of plate-like fins at certain intervals. The fin used in the device 13 may be in a shape of a circle, a four-sided figure or a spiral. The fin 13a shown in

Figure 1 is formed into a round shape, its surfaces being parallel to the rotating direction of the roller and each of the fins being disposed along the axis of the heat pipe 10 at spaced intervals so as to form the radiation device 13.

Referring now to Figure 2, a modification of fin is shown. The radiation device 13 is defined by fins 13b each having a four-sided figure shape. The plural fins 13b are radially secured to the heat pipe 10.

It will be apparent that a spiral fin (not shown) is also available to be used as the radiation device 13.

An effectiveness of radiation will be improved using such fin composition for the radiation device 13 since the fins rotate together with the roller.

Figure 4 shows an modification to compulsorily cool by air. The radiation section 12 and the radiation device 13 of the heat pipe 10 are accommodated in a case 14, all together. The case has an inlet 15 for fresh air to cool and an outlet 16 for exhaust from the radiation device where the heat exchange can be carried out. The outlet 16 can be connected with a blower 18 to exhaust the used air via a piping 17. The evaporated working fluid in the radiation section 12 of the heat pipe can be condensed and liquefied by radiating the latent heat of condensation from the radiation device 13 to the inside space of the case 14. It will be apparent that the thus radiated heat in the case 14 is exhausted by the blower 18.

An effectiveness of absorption for the latent heat of condensation will be improved since the blower 18 compulsorily exhausting useless air can expedite the condensation of the evaporated working fluid. Accordingly, the effectiveness of cooling in the roller can be improved.

Figure 5 shows another embodiment of the roller according to this invention. The shown composition is characterized to have therein two of independent heat pipes 101 and 102 which are adapted to be received in a through hole by being inserted from the ends of the roller, respectively.

Radiation sections 111, 112 of the heat pipes projected from the ends of the roller are provided with the radiation device 13 including plural fins.

It can be expected that the vaporized working fluid will be cooled faster as a circulation distance, from one portion where the working fluid is cooled to the other portion where the working fluid is heated, is shortened. When using a rather long roller having the mentioned two independent heat pipes, the roller can be cooled separately to thereby suppress the temperature gradient on the roller surface compared with a roller using a single heat pipe.

Referring to Figure 6, another embodiment of a roller according to this invention is shown. The

shown roller 30 is characterized to have a hollow portion in its body and receive plural heat pipes inside.

The roller 30 is defined by a roller body 31 having a cylindrical shape and roller shafts 33 fixed to flanges 32 attached to openings of the roller body 31. The roller shaft 33 is held in a bearing secured to the frame 2 of the whole device so as to rotate. The roller body 31 are arranged to include, as in shown Figure 7, a plurality of insertion holes 34 lengthwisely for heat pipes on a common circle. The insertion hole 34 is adapted to receive the heat pipe 10 therein. The projected portions of the respective heat pipes 10 are connected all together with a common radiation device 35.

The radiation device 35 includes, as shown in Figure 8, a plurality of disk-like fins 35a, each fin having at its center portion a hole 35b for the roller shaft 33 and also at its periphery portion holes corresponding plural heat pipes 10.

It will be apparent that the radiation device 35 in this embodiment is disposed at one side of the roller, but the same device may be provided at the other side as shown in Figure 5, wherein the heat pipe 10 were separately and lengthwisely received in the roller body 30, whereby an equivalent operation and effect in Figure 5 may be achieved.

Figure 9 shows still another embodiment of the roller according to this invention. The shown roller is characterized to have an arrangement that a roller body 41 is coupled to an inner sleeve 42 and the inner sleeve 42 is provided to receive plural heat pipes 10 therein. The shown components fulfilling the same function as the mentioned embodiment in Figure 8 are denoted by the same numerals and the corresponding explanation will be obviated.

The roller 40 is assembled so that the cylindrical roller body 41 is coupled to the inner sleeve 42 by means of a press fitting or a shrinkage fitting and the heat pipes 10 are inserted into through holes 43 of the inner sleeve 42.

It will be noted that the heat pipes 10 are disposed on a common circle in the inner sleeve 42, but when the inner sleeve 42 has a certain thickness, another arrangement of the heat pipes 10 that are on two different circles and in a radial pattern not to radially aligned each other is also available as shown in Figure 11. That is, there are an outer series of the heat pipes 10a near the roller surface and an inner series of the heat pipes 10b, each of pipes 10b being oriented intermediate one heat pipe 10a and another. When employing such arrangement of heat pipes, the temperature gradient in a circumferential direction on the roller surface can be suppressed.

Figure 12 also presents another embodiment of the roller according to this invention. In this em-

bodiment, the inner surface of the roller body 41 does not directly contact with the outer surface of the inner sleeve 42 but there is provided a layer of a high-thermal transmissible cement 44 between members 41 and 42 to advance an efficiency of thermal transmission between the two members. This arrangement does not require a high precision of processing the inner surface of the roller body and the outer surface of the inner sleeve, which facilitates an easy machine processing.

Figure 14 shows still another embodiment of the roller in this invention. This embodiment is characterized to include a heat-inlet section of the heat pipe in the hollow roller body.

The roller 50 is defined by a roller body 51 being of a hollow cylinder opened both ends and roller shafts 52a fixed to flanges 52 attached to openings of the roller body 51. The roller shaft 52a is held in a bearing 5 secured to the frame 2 of the whole device so as to rotate.

A sleeve 53 is provided in the roller body 51 to hold therein a heat pipe 10 axially aligned with the roller shaft 52a. One end of the sleeve 53 is secured to one flange 52 and the other is kept in the other flange 52 and the roller shaft 52a to thereby rotate along with the roller body. The sleeve 53 is provided with a thermal absorption device 54 defined by plural fins in the roller body. A portion of the heat pipe 10 extended from the sleeve 53 has the radiation device 13 defined by fins.

The radiation device 13 is covered with a case 55 which houses a heat/cool device 60 employing electrical thermal elements. The heat/cool device 60 comprises a thermal electrode 61a, an electrical thermal element 61 having a heat release electrode 61b, a heat release fin 62 attached to the heat release electrode 61b of the electrical thermal element 61, a fan case 63 to cover the heat release fin 62, and an air fan 64.

Attaching the fan case 63 to the case 55, the thermal electrode 61a is oriented in the case 55. A reversible operation of the electrical thermal element 61 may facilitate an absorption of heat radiated from the heat pipe 10 or an application of heat thereto.

When cooling the roller, the heat/cool device 60 is operated as to be a cooling device in order to take out unnecessary heat from the radiation section of the heat pipe (in the case 55). In this case, the air fan 64 draws fresh air via an inlet opening 65 of the fan case and the unnecessary heat is removed from the heat release fin 62. The vaporized working fluid in the radiation section of the heat pipe can be appropriately liquefied, so that the cooling effectiveness of the roller is accelerated to return to the heat-inlet section.

In the mentioned embodiment, the roller is heated or cooled by controlling the electrical thermal element. It will be apparent that the heat/cool device employing the electrical thermal element is not only utilized in the roller shown in Figure 14, but also in other rollers already explained.

It will be mentioned, however, that when heating the roller, a portion of the heat pipe extended from the roller body will be used as the heat-inlet section and a portion of the heat pipe in the roller body will be used as the radiation portion. In this composition, the heat-inlet section will be heated. If the roller is provided with the heat/cool device using the electrical thermal element, the roller can be heated easily by reversing the electrical current to the electrical thermal element.

### Claims

1. A roller to be heated or cooled, comprising at least one heat pipe (10) which is arranged inside the roller body (3) and which has a heat exchange relationship with said roller body, wherein at least one end of said heat pipe (10) projects from said roller and is coupled to heating or cooling means (13).
2. A roller to be heated or cooled according to claim 1, comprising a solid roller body (3) having one or more holes provided from at least one end along a central axis thereof; and one or more heat pipes (10; 101, 102) coupled into the holes of said roller body (3) to partly extend therefrom, so that said roller is heated or cooled by a heat exchange of said heat pipes (10; 101, 102).
3. A roller to be heated or cooled according to claim 1, comprising:  
a hollow roller body (31) having a plurality of through holes (34) each parallel to a line segment forming a side of said roller body (31); and heat pipes (10) coupled into the through holes (34) of said roller body (31) to partly extend therefrom, so that said roller is heated or cooled by a heat exchange of said heat pipes (10).
4. A roller to be heated or cooled according to claim 1, comprising:  
a hollow roller body (41);  
an inner member (42) entirely coupled into said hollow roller body (41) and including a plurality of through holes (43); and  
heat pipes (10) coupled into the through holes (43) of said inner member (42) to partly extend therefrom, so that said roller is heated or cooled by a heat exchange of said heat pipes.

5. A roller to be heated or cooled according to claim 1, comprising:  
a hollow roller body (41);  
an inner member (42) entirely loosely coupled into said hollow roller body (41) and including a plurality of through holes (43);  
heat pipes (10) coupled into the through holes (43) of said inner member to partly extend therefrom; and  
a layer (44) of a high-thermal transmissible cement between said hollow roller body (41) and said inner member (42) to advance an efficiency of thermal transmission therebetween, so that said roller is heated or cooled by a heat exchange of said heat pipes.
6. A roller to be heated or cooled according to claim 1, comprising:  
a roller body (51) having therein a sealed-up space;  
a sleeve (53) having fins (54) lengthwisely in the space of said roller body (51); and  
a heat pipe coupled into said sleeve (53) to partly extend therefrom, so that said roller is heated or cooled by a heat exchange of said heat pipe.
7. A roller to be heated or cooled according to any one of claims 1 and 6, comprising:  
a roller body (51);  
one or more heat pipes (10) partly extending from said roller body (51); and  
fins (13) provided at a partly extended portion of said heat pipes (10), so that said roller is heated or cooled by a heat exchange of said pipes.
8. A roller to be heated or cooled according to claim 7, wherein said roller (50) further comprises a case (55) to cover said fins (13) and an air fan (64) to ventilate a case.
9. A roller to be heated or cooled according to claims 7 or 8, wherein said roller (50) further comprising a case (55) to cover said fins (13) and a heat/cool device (60) using an electrical thermal element (61) at said case.
10. A roller to be heated or cooled according to claims 1 or 2, comprising:  
a roller body (3); and  
heat pipes (101, 102) partly extending from said roller body, said each heat pipe (101, 102) having nearly half the length of said roller body (3) and being capable of being inserted into said roller body (3) from both ends.

FIG. 1

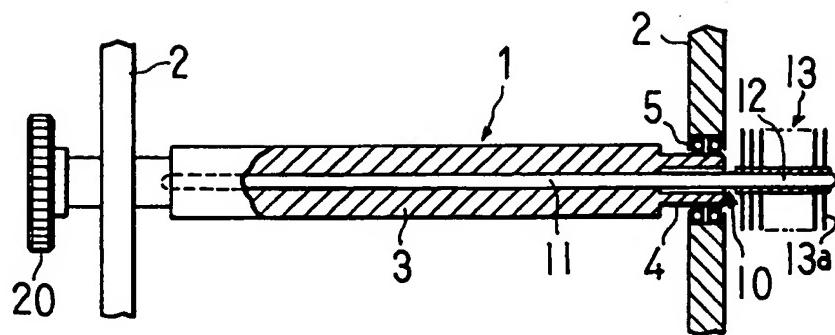


FIG. 2

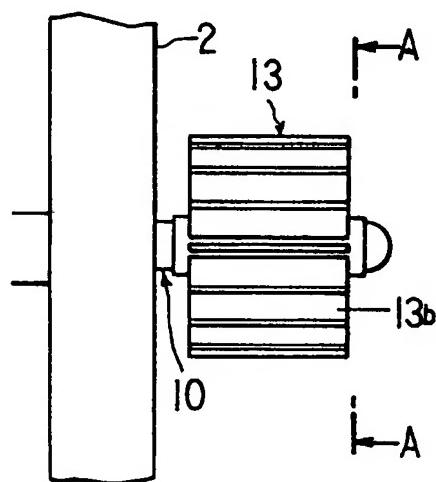


FIG. 3

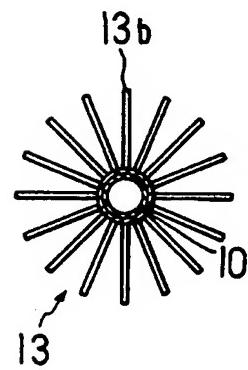


FIG.4

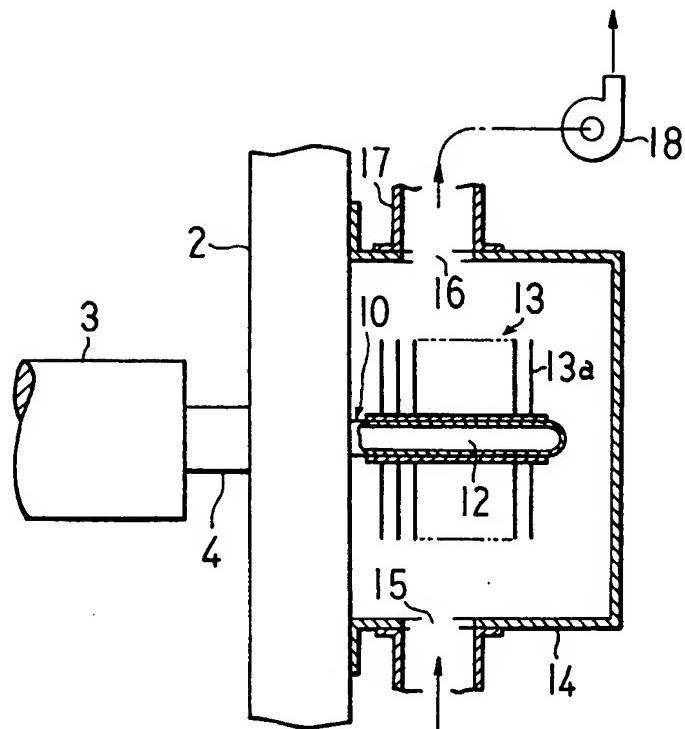


FIG.5

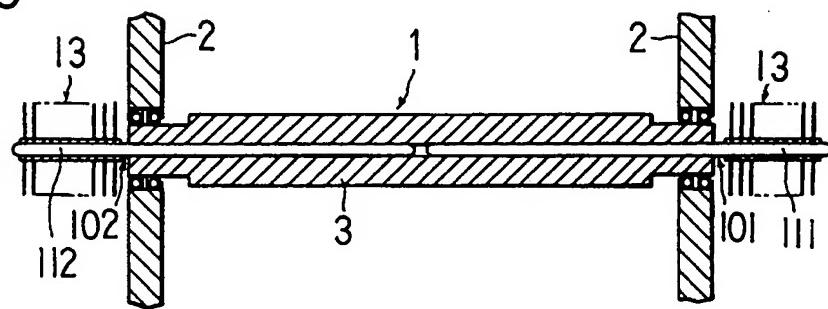


FIG.6

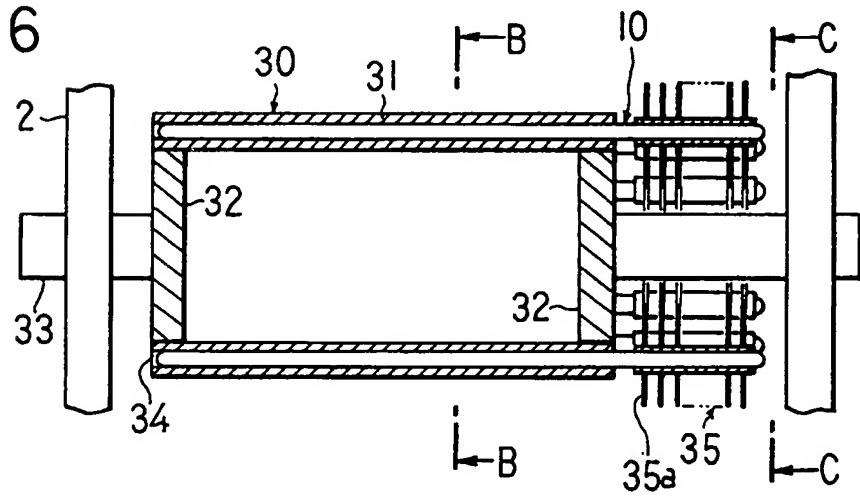


FIG.7

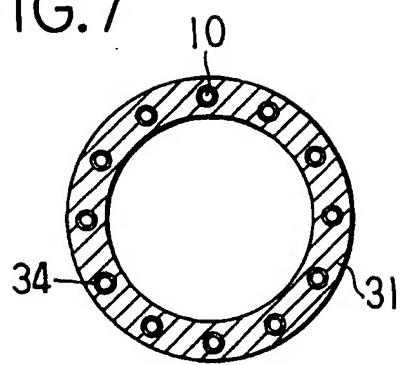


FIG.8

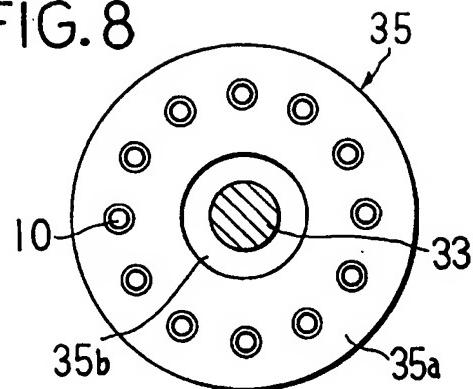


FIG.9

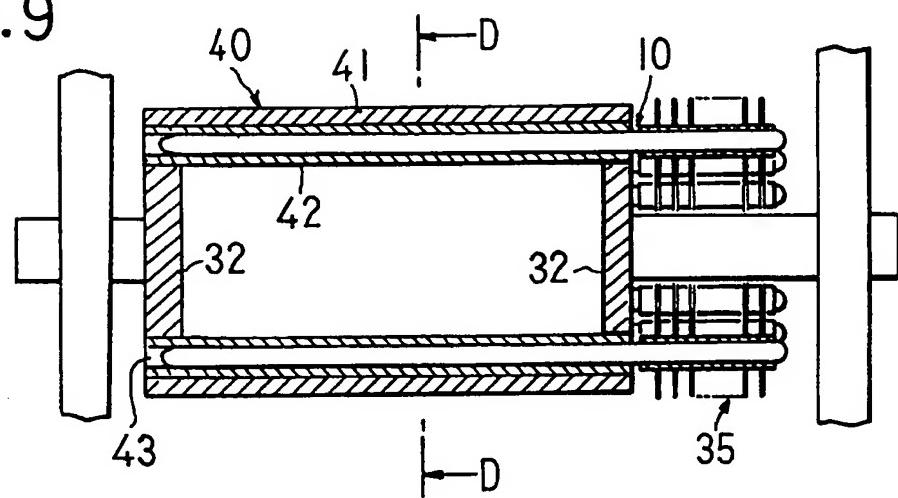


FIG.10

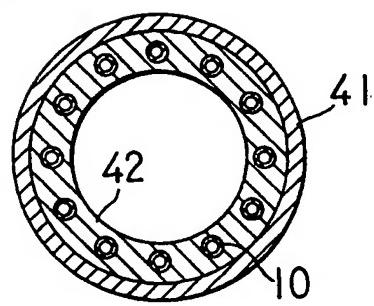


FIG.11

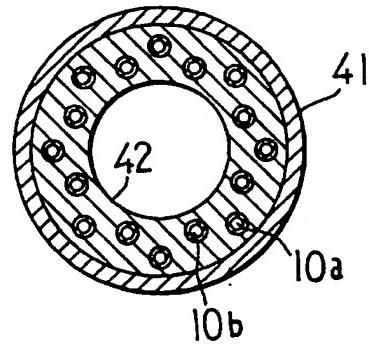


FIG.12

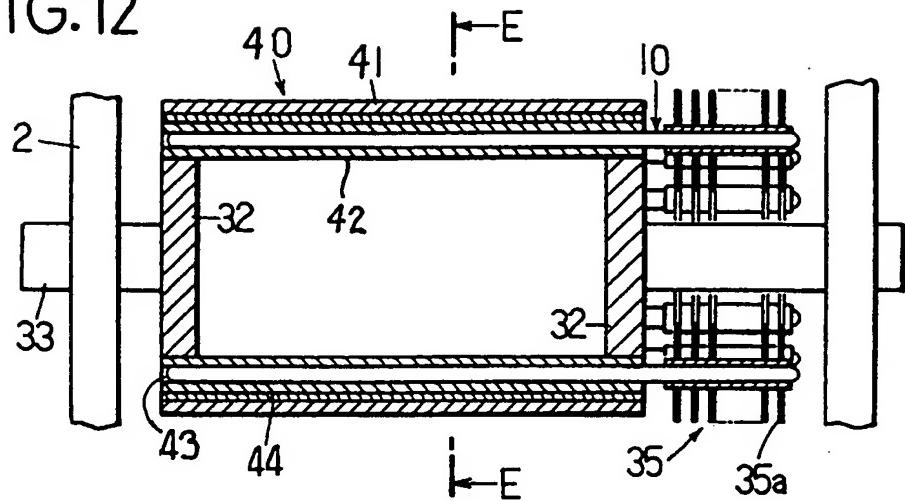


FIG. 13

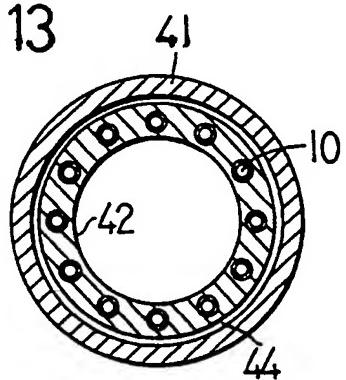
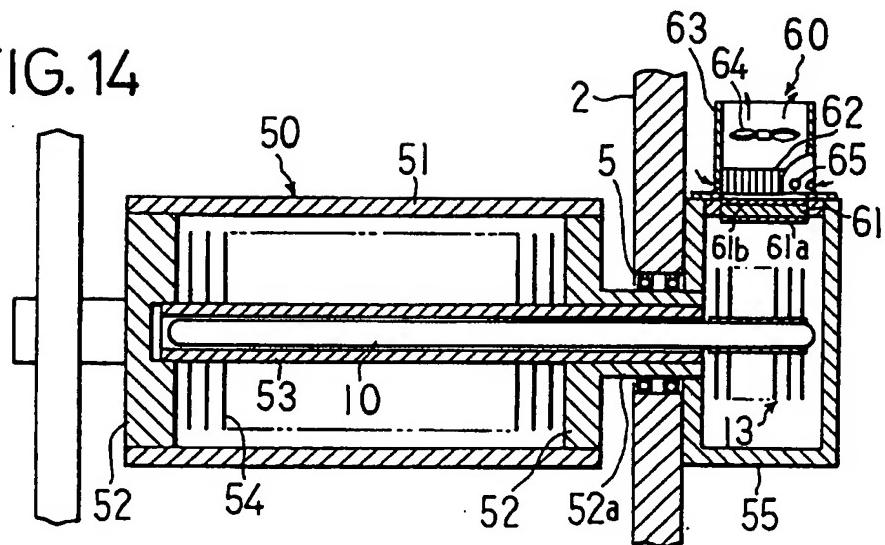


FIG. 14





**European Patent  
Office**

## **EUROPEAN SEARCH REPORT**

**Application Number**

EP 93 10 2544

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl.5)
A	PATENT ABSTRACTS OF JAPAN vol. 008, no. 182 (M-319)(1619) 22 August 1984 & JP-A-59 073 952 ( TOPPAN INSATSU K.K. ) * abstract * ---	1	B41F31/00 // F28D15/02
D,A	PATENT ABSTRACTS OF JAPAN vol. 012, no. 201 (M-707)(3048) 10 June 1988 & JP-A-63 005 944 ( SEIICHI KUROSAWA )		
A	& GB-A-2 207 636 (SEIICHI KUROSAWA) ---		
D,A	PATENT ABSTRACTS OF JAPAN vol. 015, no. 142 (M-1101) 10 April 1991 & JP-A-30 21 453 ( MITSUBISHI HEAVY IND LTD ) -----		
			TECHNICAL FIELDS SEARCHED (Int. Cl.5)
			B41F F28D
The present search report has been drawn up for all claims			
Place of search	Date of compilation of the search	Examiner	
THE HAGUE	29 JULY 1993	BOURSEAU A.M.	
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X : particularly relevant if taken alone	T : theory or principle underlying the invention		
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